

284

# Bronchiectasis

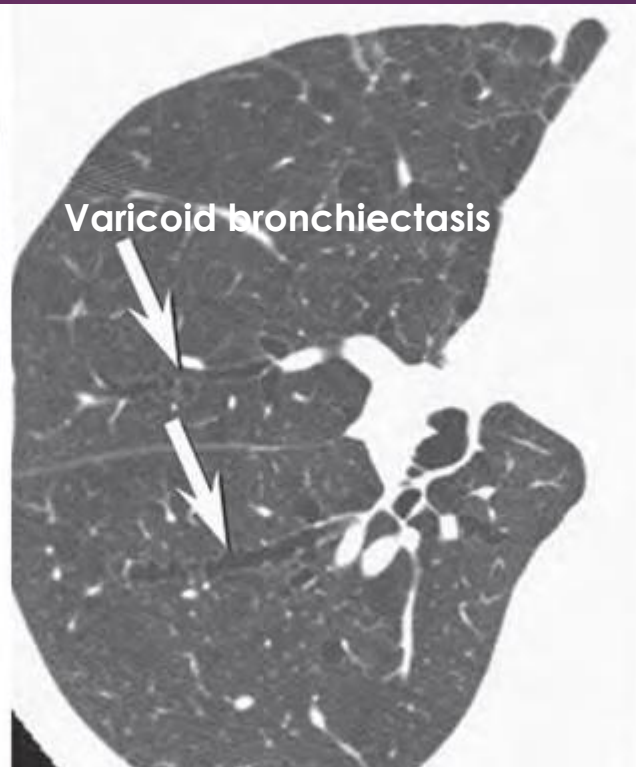
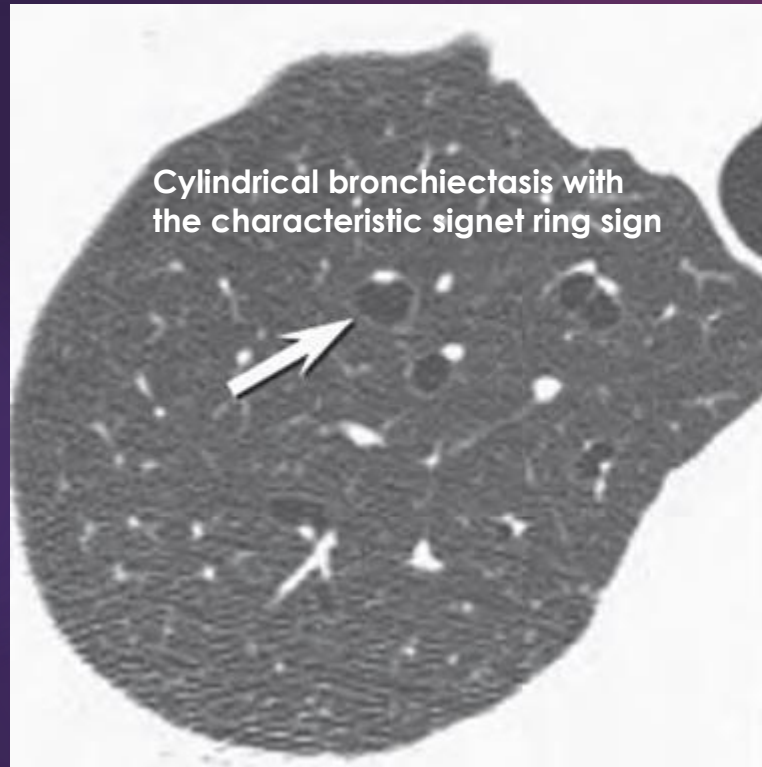
**Rebecca M. Baron, Miriam Baron Barshak**

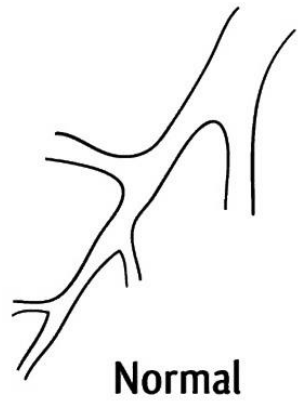


DR. M.FARZMEHDI



# Bronchiectasis

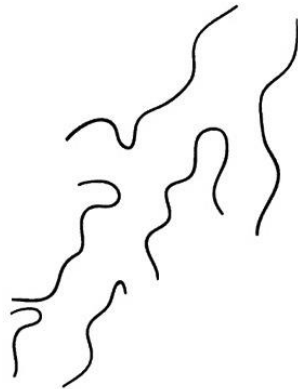




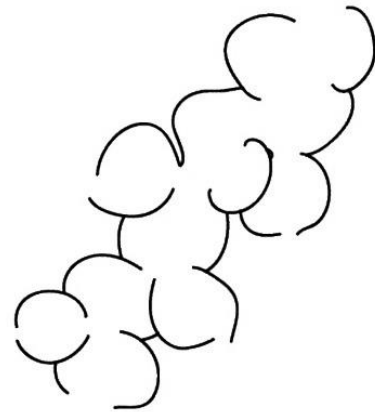
Normal



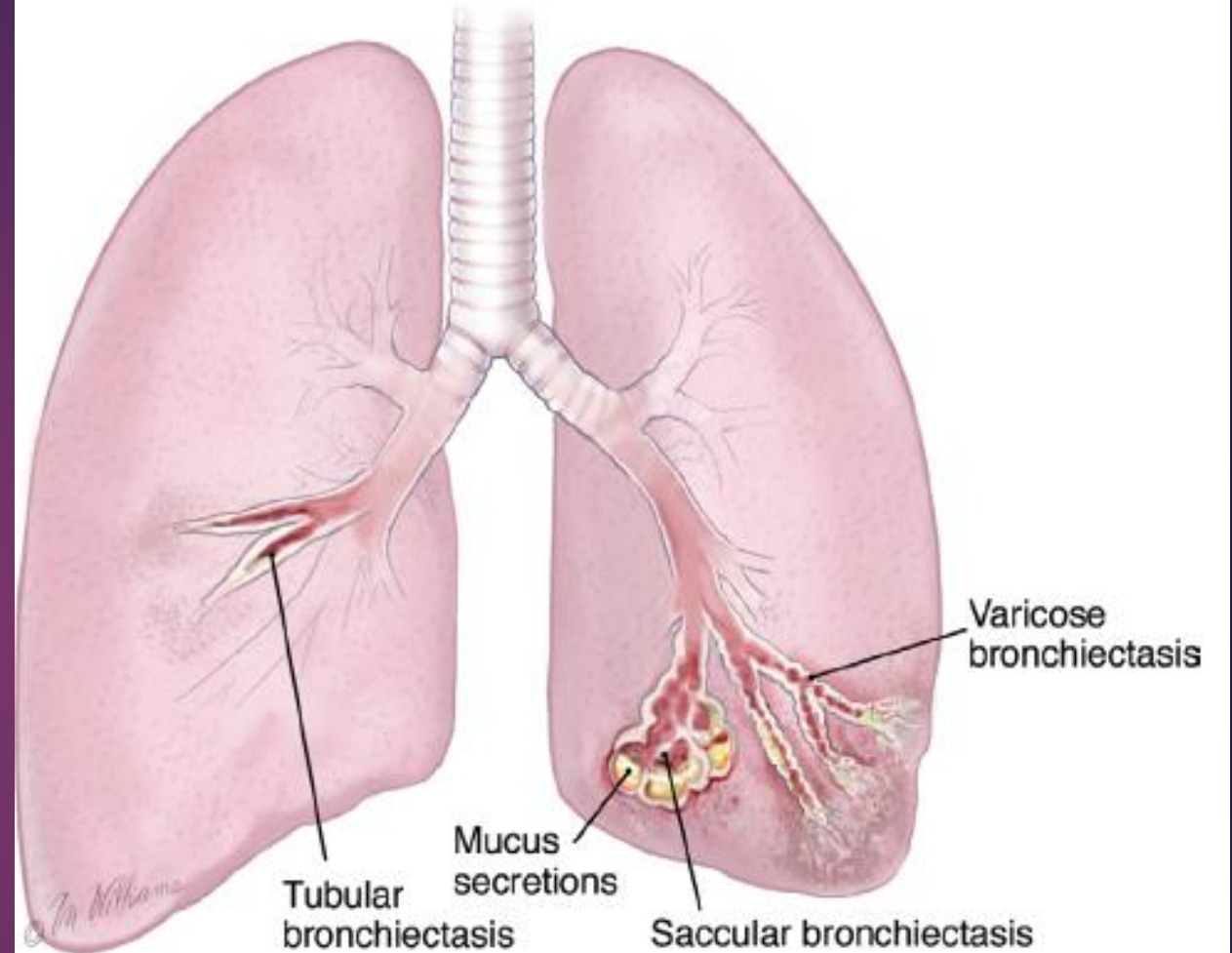
Cylindrical



Varicose



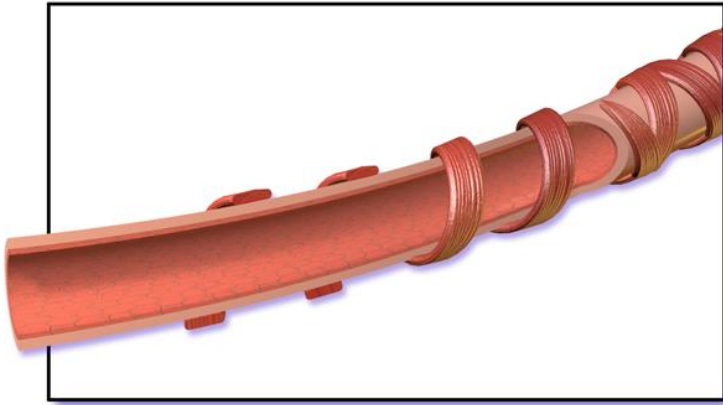
Cystic



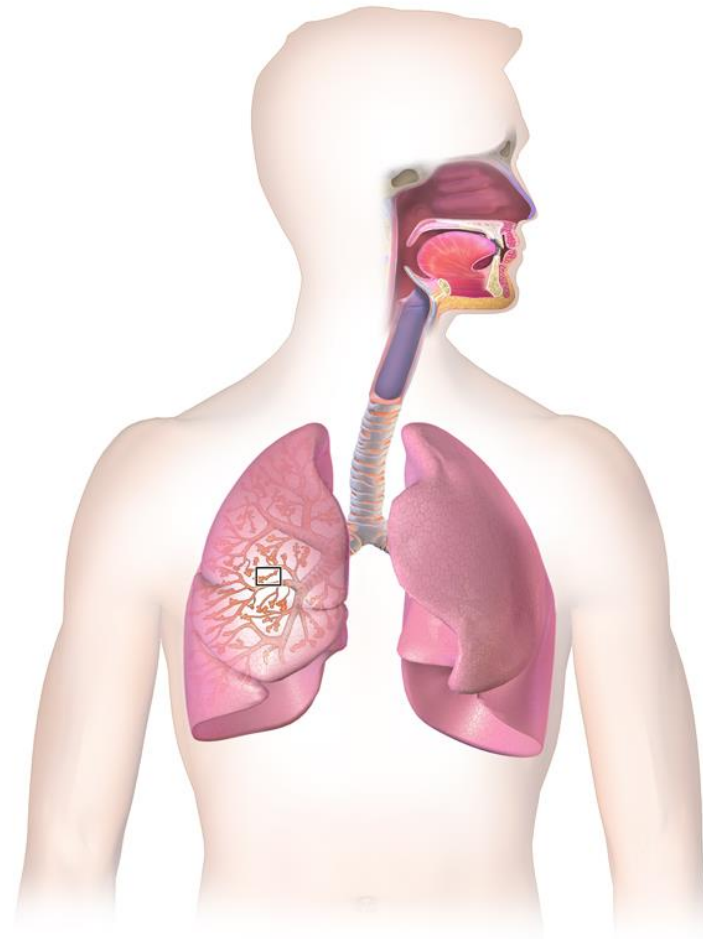
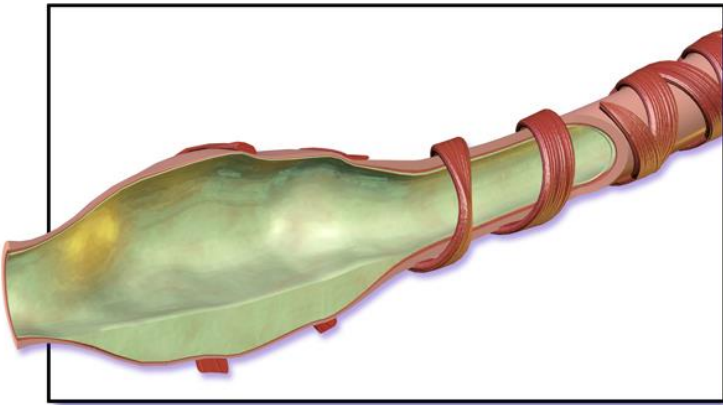
Source: D. J. Sugarbaker, R. Bueno, Y. L. Colson, M. T. Jaklitsch, M. J. Krasna, S. J. Mentzer, M. Williams, A. Adams: *Adult Chest Surgery*, 2nd Edition: [www.accesssurgery.com](http://www.accesssurgery.com)  
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*Normal Airway*



*Airway with Bronchiectasis*



**Bronchiectasis**

# ETIOLOGY

## Focal

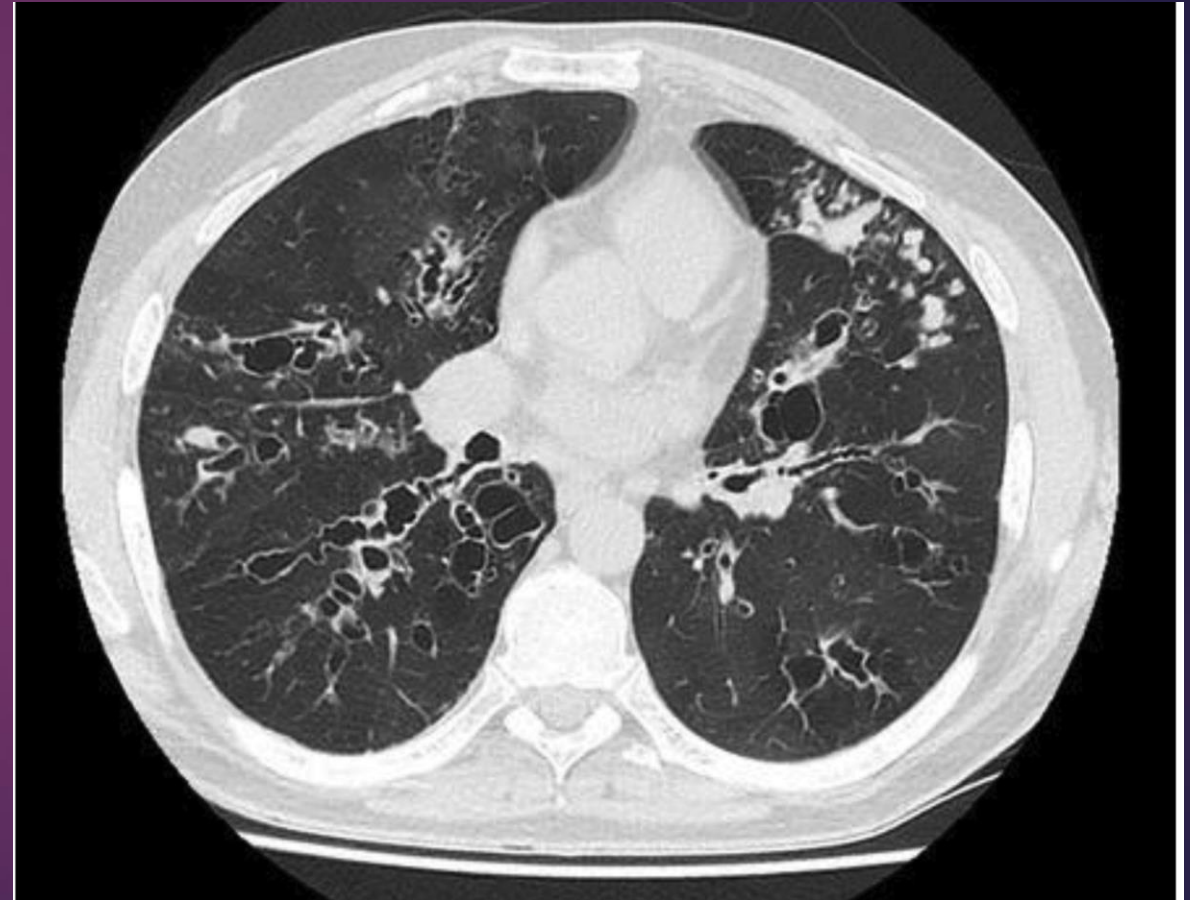
- ▶ Obstruction
  - ▶ Extrinsic
    - ▶ lymphadenopathy
    - ▶ parenchymal tumor mass
  - ▶ Intrinsic
    - ▶ airway tumor
    - ▶ aspirated foreign body
    - ▶ scarred/stenotic airway
    - ▶ bronchial atresia
- ▶ Chest imaging (chest x-ray and/or chest CT);
- ▶ Bronchoscopy



# ETIOLOGY

## Diffuse

- ▶ Infectious
  - ▶ bacterial, TB , fungi
  - ▶ nontuberculous mycobacterial
  - ▶ Recurrent aspiration
- ▶ Noninfectious
  - ▶ Immunodeficiency
  - ▶ Genetic
  - ▶ Autoimmune or rheumatologic
  - ▶ Miscellaneous
    - ▶ Yellow nail syndrome
    - ▶ Traction bronchiectasis
      - ▶ postradiation fibrosis
      - ▶ idiopathic pulmonary fibrosis
  - ▶ Idiopathic 25–50%



# ETIOLOGY

## Diffuse: upper lung fields

- ▶ cystic fibrosis (CF)
- ▶ Postradiation fibrosis

# ETIOLOGY

Diffuse: Lower lung fields

- ▶ ***Chronic recurrent aspiration***
  - ▶ esophageal motility disorders like those in scleroderma
- ▶ ***End stage fibrotic lung disease***
  - ▶ Traction bronchiectasis from IPF
- ▶ ***Recurrent immunodeficiency-associated infections***
  - ▶ Hypogammaglobulinemia



# ETIOLOGY

## Diffuse: midlung fields

### ▶ **NTM**

- ▶ Mycobacterium avium-intracellulare complex (MAC)

### ▶ ***Dyskinetic / immotile cilia syndrome***

### ▶ **ABPA**


- ▶ immune-mediated reaction to Aspergillus damages the bronchial wall

### ▶ ***Congenital***

- ▶ cartilage deficiency
  - ▶ Tracheobronchomegaly (Mounier-Kuhn syndrome)
  - ▶ Williams-Campbell syndrome

# EPIDEMIOLOGY

## Bronchiectasis

- ▶ Prevalence 
- ▶ Varies greatly with the underlying etiology
  - ▶ CF in late adolescence or early adulthood
  - ▶ Atypical CF in adults in their thirties and forties
- ▶ MAC infection
  - ▶ nonsmoking women >50 years of age
- ▶ incidence of bronchiectasis increases with age
- ▶ women > men
- ▶ reactivated tuberculosis
  - ▶ sequela of granulomatous infection
- ▶ increased incidence of non-CF bronchiectasis?

# PATHOGENESIS AND PATHOLOGY

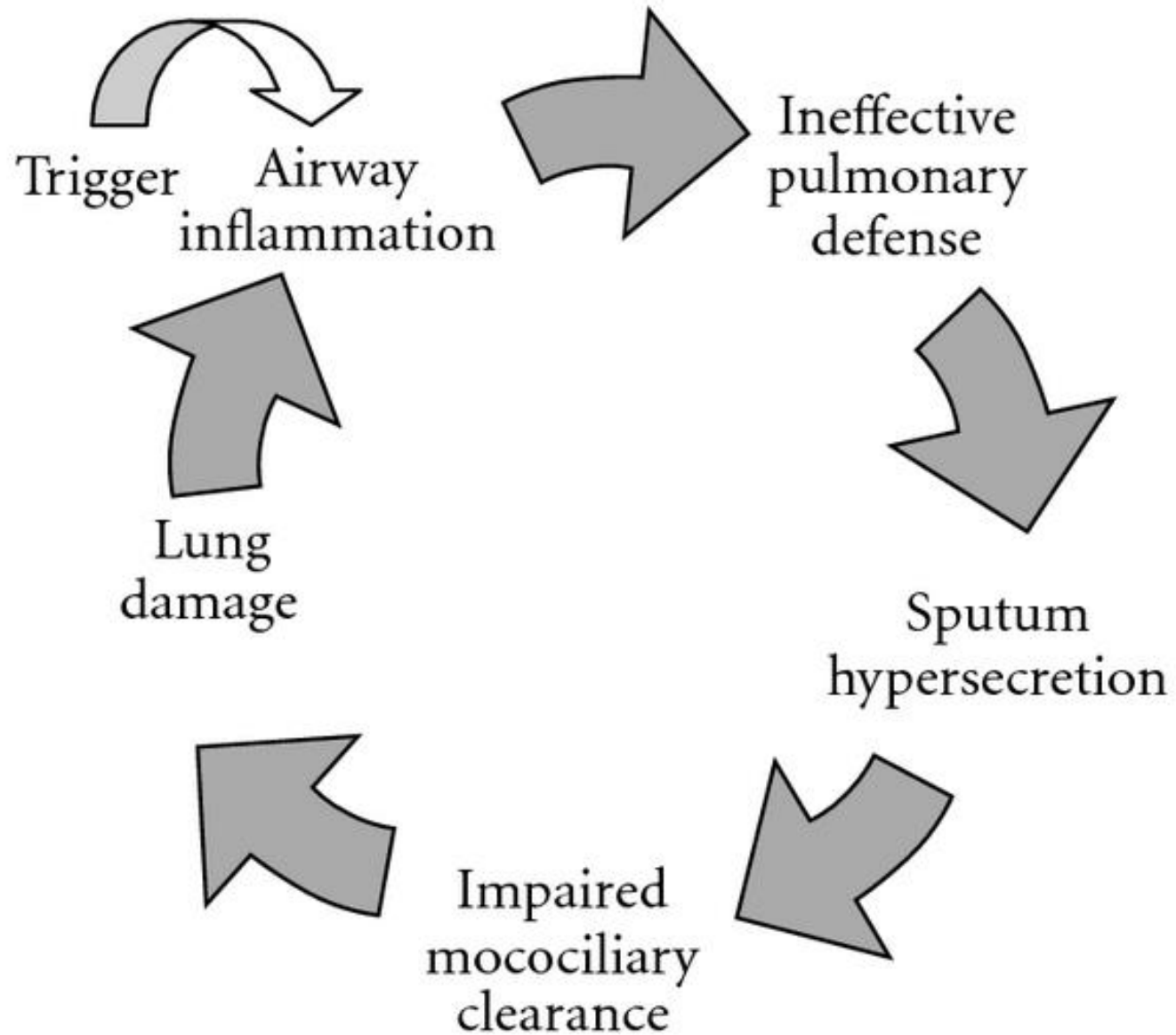
## Bronchiectasis

- ▶ mechanism of infectious bronchiectasis
- ▶ **“vicious cycle hypothesis,”**
  - ▶ susceptibility to infection
  - ▶ poor mucociliary clearance



result in

- ▶ microbial colonization of the bronchial tree






# Pseudomonas aeruginosa

- ▶ colonizing damaged airways
- ▶ Evading host defense mechanisms
- ▶ Impaired mucociliary clearance

# pathology of bronchiectasis

- ▶ significant small-airway wall inflammation
- ▶ larger-airway wall destruction as well as dilation
  - ▶ loss of elastin, smooth muscle, and cartilage
  - ▶ release proteases and other mediators
  - ▶ reactive oxygen species and proinflammatory cytokines
  - ▶ damage the larger-airway walls
- ▶ airflow obstruction
- ▶ Antiproteases
- ▶  $\alpha$ 1 antitrypsin
  - ▶ neutralizing the damaging effects of neutrophil elastase
  - ▶ enhancing bacterial killing
- ▶  $\alpha$ 1 antitrypsin deficiency  Bronchiectasis and emphysema

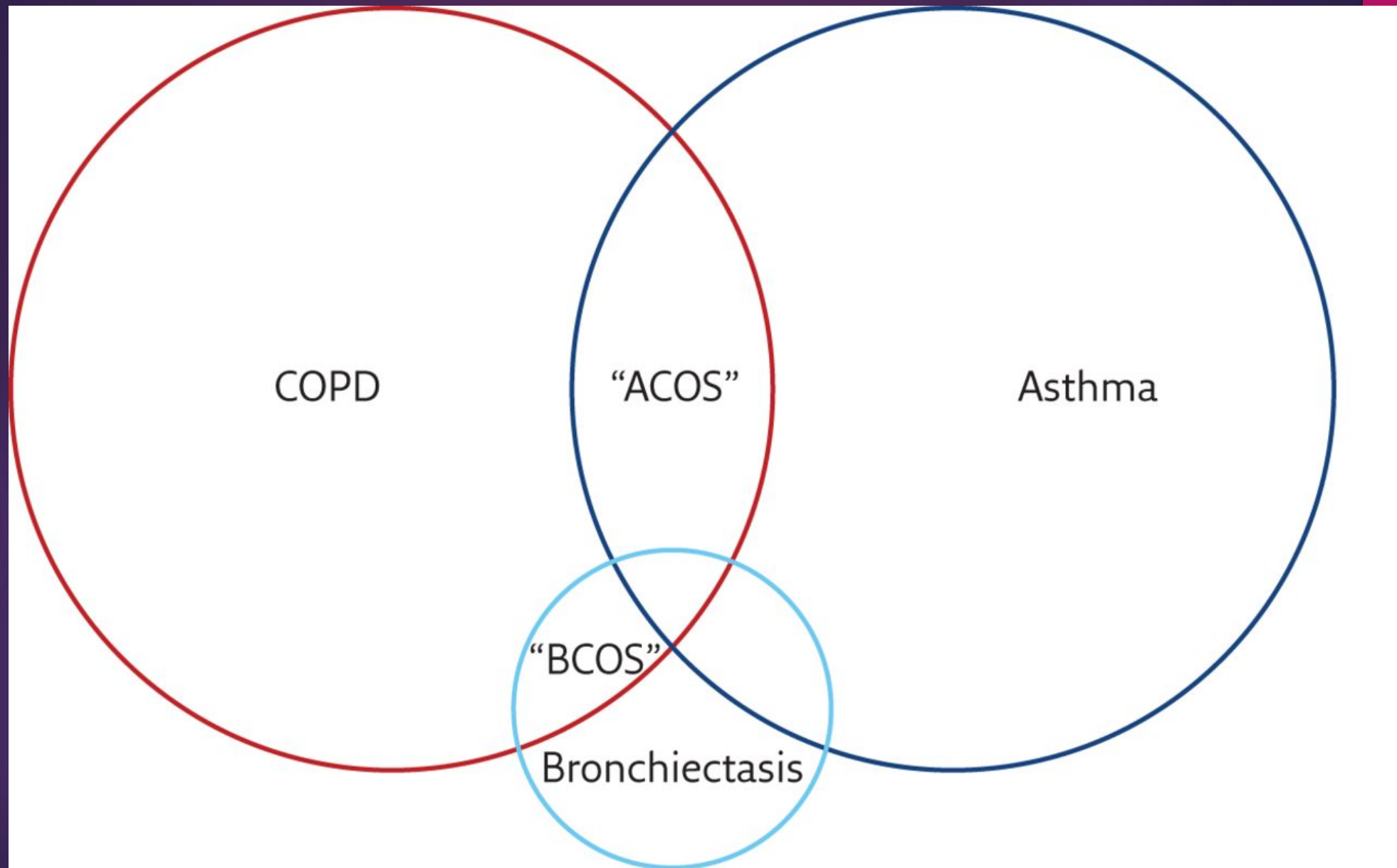
# noninfectious bronchiectasis

## ▶ ***immune-mediated reactions***

- ▶ Sjögren's syndrome
- ▶ Rheumatoid arthritis

## ▶ ***Traction bronchiectasis a result of lung fibrosis***

- ▶ postradiation fibrosis
- ▶ idiopathic pulmonary fibrosis





# CLINICAL MANIFESTATIONS

- ▶ Productive cough
  - ▶ thick, tenacious sputum
- ▶ crackles and wheezing on lung auscultation
- ▶ clubbing
- ▶ Mild to moderate airflow obstruction

# CLINICAL MANIFESTATIONS

## Acute exacerbations of bronchiectasis

- ▶ changes in the nature of sputum production
  - ▶ increased volume and purulence
- ▶ Fever and new infiltrates, may not be present

# DIAGNOSIS

- ▶ Persistent chronic cough and sputum production

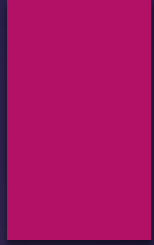
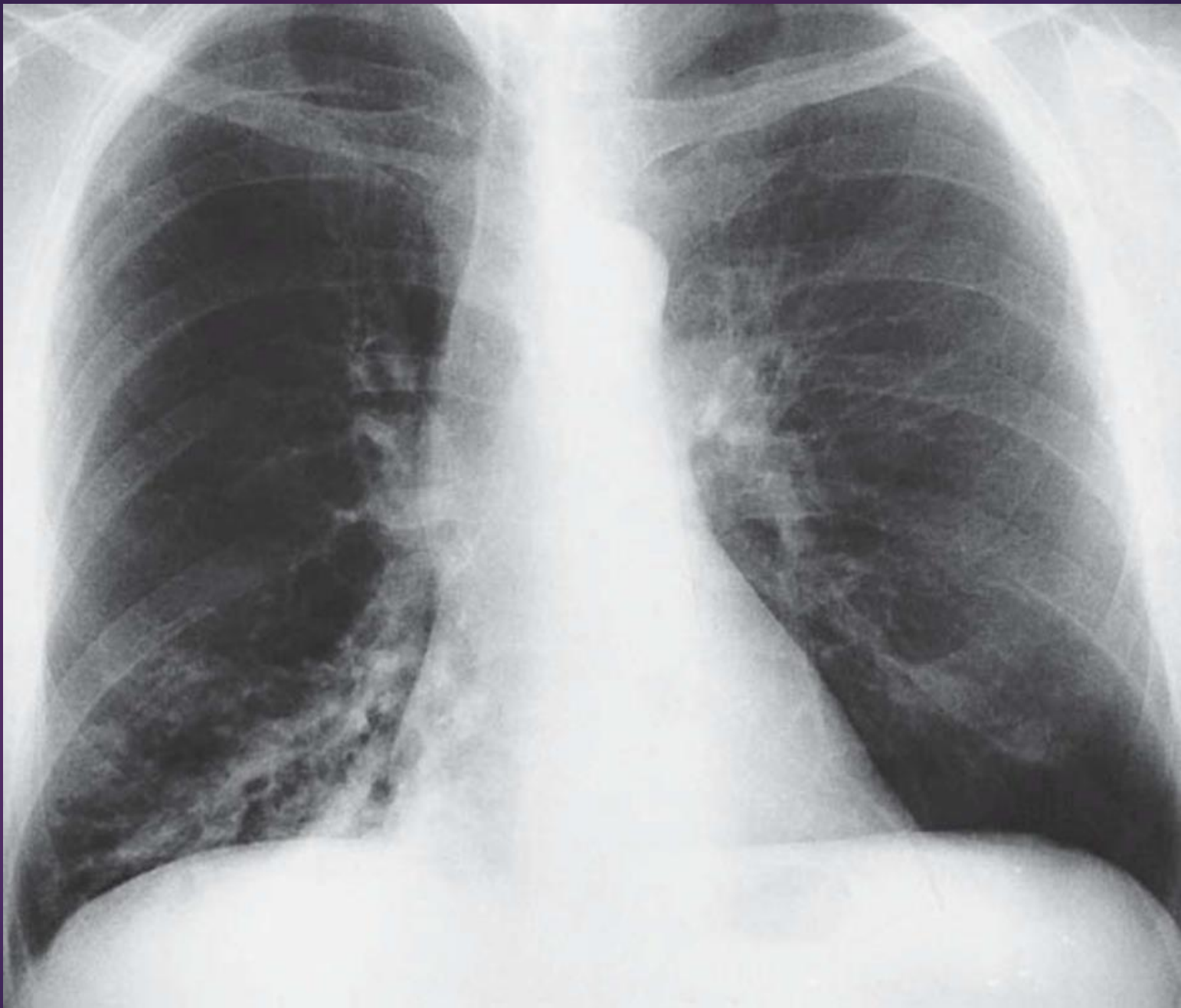


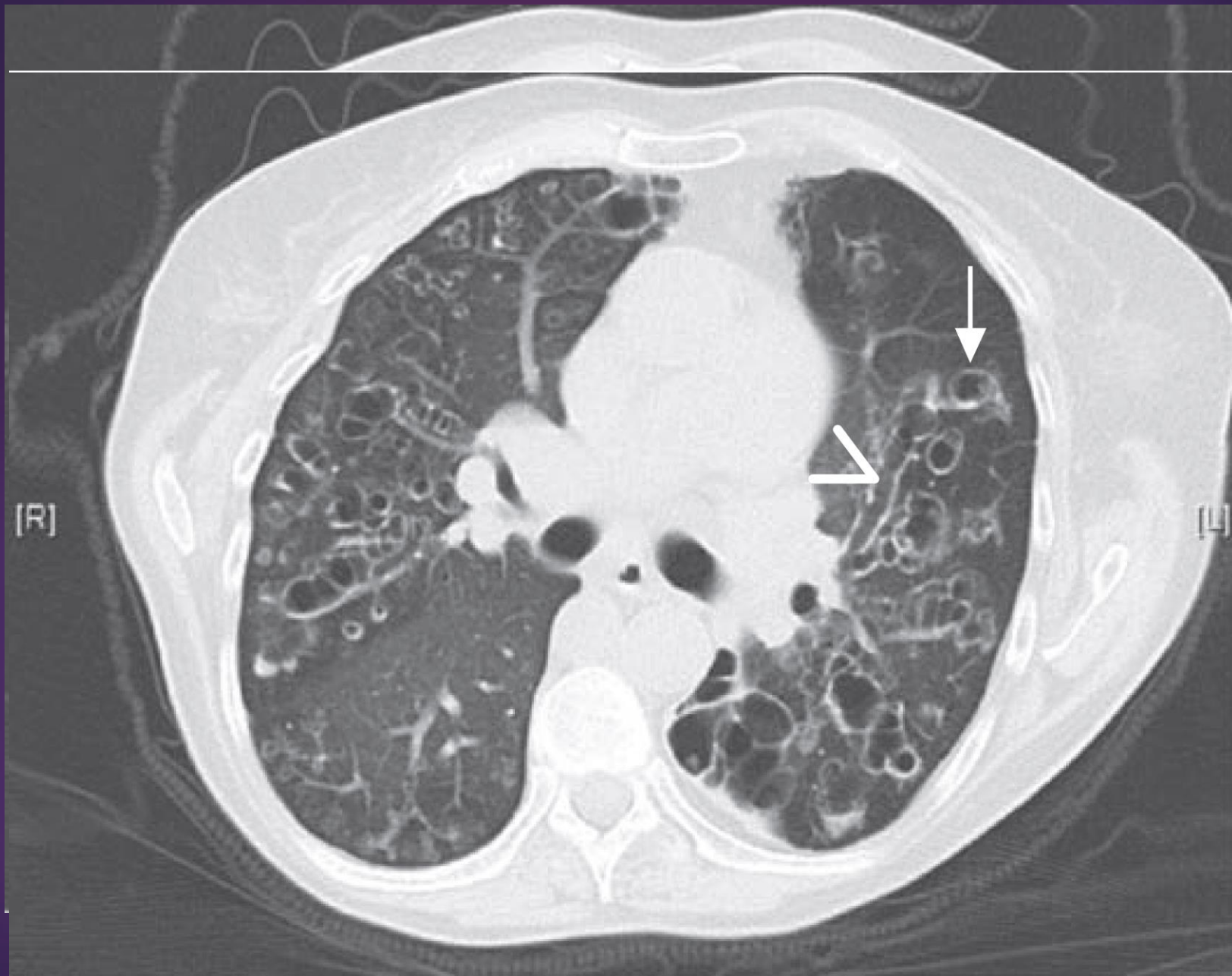
- ▶ Consistent radiographic features

# DIAGNOSIS

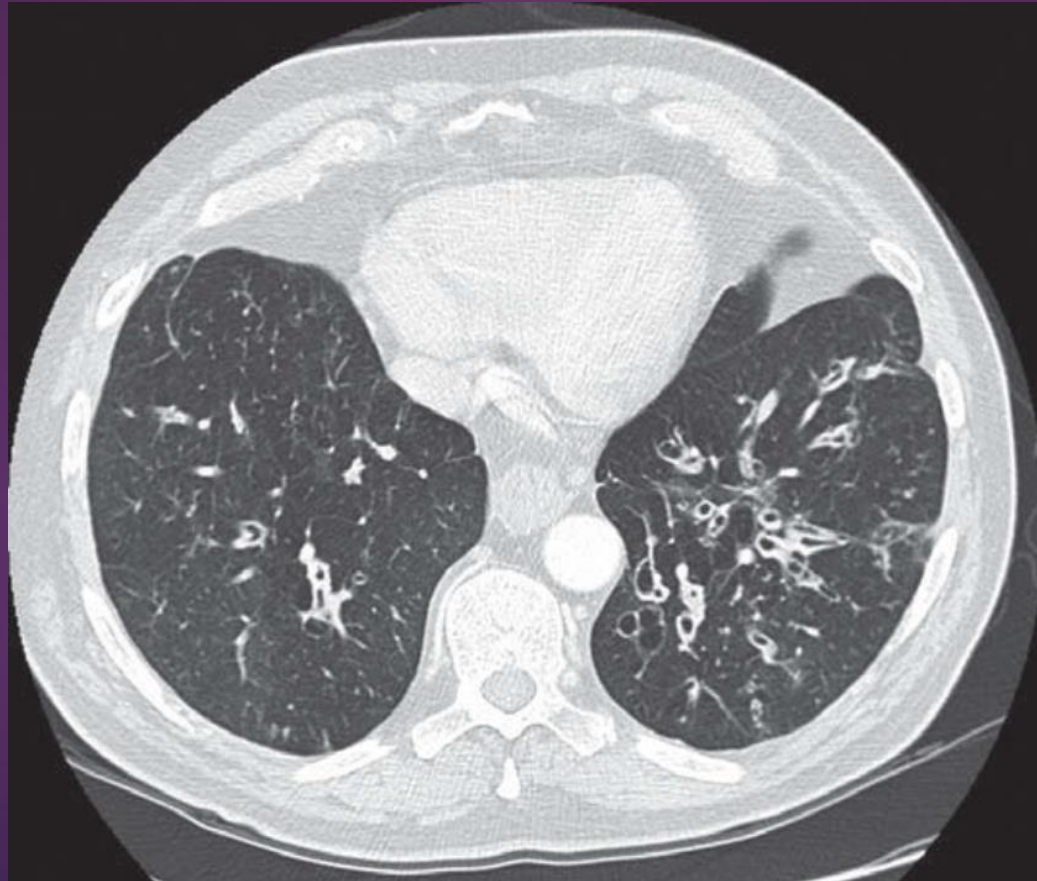
- ▶ Chest radiographs lack sensitivity → “tram tracks”
- ▶ Chest CT
  - ▶ airway dilation
  - ▶ “signet-ring sign”
  - ▶ lack of bronchial tapering
  - ▶ bronchial wall thickening
  - ▶ Impassated secretions ( “tree-in-bud” pattern)
  - ▶ cystic bronchiectasis





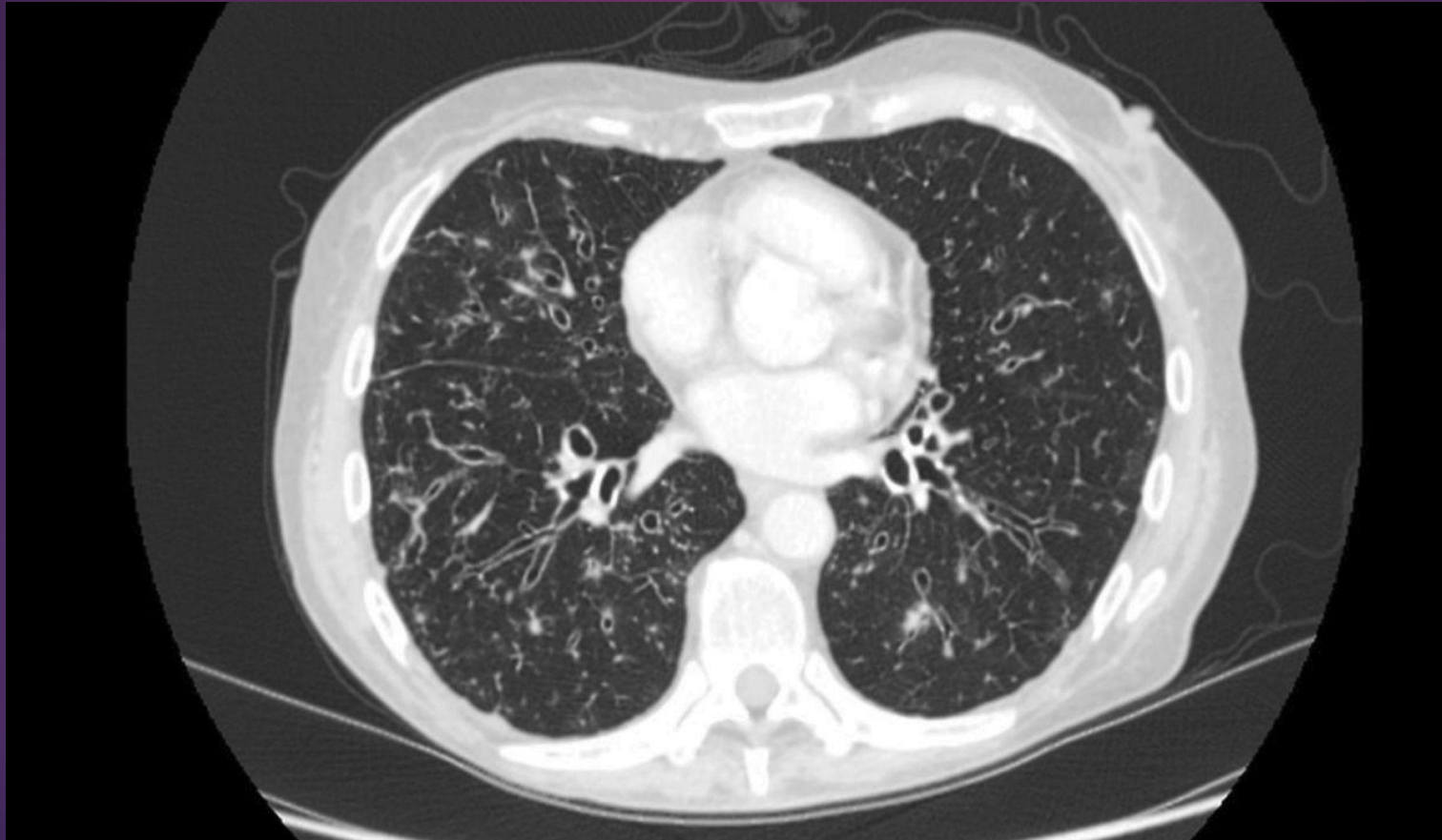


# Bronchiectasis





# Bronchiectasis





# APPROACH TO THE PATIENT

## Bronchiectasis

- ▶ *clinical history*
- ▶ *chest imaging*
- ▶ *workup to determine the underlying etiology*

# APPROACH TO THE PATIENT

## Focal bronchiectasis

- ▶ Almost always requires bronchoscopy



- ▶ airway obstruction by an underlying mass or foreign body

# APPROACH TO THE PATIENT

## Diffuse bronchiectasis

- ▶ analysis for the major etiologies



- ▶ initial focus on excluding CF
- ▶ Pulmonary function testing

# TREATMENT

## Bronchiectasis

- ▶ control of active infection
- ▶ improvements in secretion clearance
- ▶ bronchial hygiene
  - ▶ decrease the microbial load within the airways
  - ▶ minimize the risk of repeated infections

# ANTIBIOTIC TREATMENT

- ▶ *Haemophilus influenzae*
- ▶ *P. aeruginosa*
- ▶ acute exacerbations
  - ▶ 7–10 days and perhaps for as long as 14 days
- ▶ NTM infection can be difficult
  - ▶ two sputum samples positive on culture
  - ▶ one BAL fluid sample positive on culture;
  - ▶ a biopsy sample displaying histopathologic features of NTM infection
    - ▶ granuloma or a positive stain for acid-fast bacilli
  - ▶ one positive sputum culture; + pleural fluid sample positive on culture
- ▶ macrolide-sensitive MAC
  - ▶ macrolide combined with rifampin and ethambutol

# BRONCHIAL HYGIENE

- ▶ hydration
- ▶ mucolytic administration
- ▶ bronchodilators
- ▶ hyperosmolar agents (e.g., hypertonic saline),
- ▶ chest physiotherapy (postural drainage, mechanical chest percussion)
- ▶ Pulmonary rehabilitation and a regular exercise program
  - ▶ improved exercise capacity and quality of life
- ▶ mucolytic dornase (DNase)
  - ▶ CF-related bronchiectasis



# ANTI-INFLAMMATORY THERAPY

## Glucocorticoids

- ▶ inhaled glucocorticoids
  - ▶ alleviated dyspnea
  - ▶ decreased need for inhaled  $\beta$ -agonists
  - ▶ reduced sputum production — **no significant differences**
  - ▶ **lung function**
  - ▶ **bronchiectasis exacerbation rates**

# oral/systemic Glucocorticoids

- ▶  Risks of immunosuppression
- ▶ adrenal suppression

- ▶ **ABPA**


- ▶ **noninfectious bronchiectasis**

- ▶ Rheumatoid arthritis
  - ▶ Sjögren's syndrome

- ▶ ABPA

- ▶ oral antifungal agent itraconazole

# REFRACTORY CASES

- ▶ Surgery
  - ▶ resection of a focal area of suppuration
- ▶ In advanced cases  lung transplantation

# ■ COMPLICATIONS

- ▶ In more severe cases
- ▶ recurrent infections & repeated courses of antibiotics



can  
lead to

- ▶ microbial resistance to antibiotics
- ▶ combinations of antibiotics
- ▶ life-threatening hemoptysis
  - ▶ intubation
    - ▶ identification of the source of bleeding
    - ▶ protection of the nonbleeding lung
  - ▶ bronchial artery embolization and, in severe cases, surgery

# ■ PROGNOSIS

- ▶ Outcomes of bronchiectasis
  - ▶ Underlying etiology
  - ▶ comorbid conditions
  - ▶ frequency of exacerbations
  - ▶ specific pathogens involved
    - ▶ *P. aeruginosa* colonization
- ▶ clinical, radiographic, and microbial features
- ▶ Assessment of quality of life and disease severity
- ▶ FEV1 declining by 50–55 mL per year
  - ▶ 20–30 mL per year for healthy controls

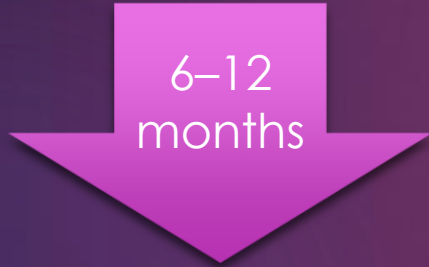
# ■ PREVENTION

- ▶ **Reversal of an underlying immunodeficient state**
  - ▶ administration of gamma globulin for immunoglobulin-deficient
- ▶ **vaccination**
  - ▶ influenza and pneumococcal vaccines
- ▶ **Smoking cessation**

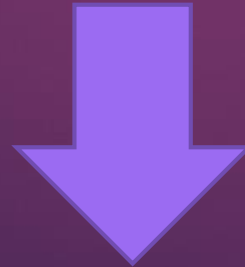


# TREATMENT

- ▶ After resolution of an acute infection
- ▶ in patients with recurrences (  $\geq 3$  episodes per year)



- ▶ suppressive antibiotics
  - ▶ frequency of exacerbations
  - ▶ mucus production
  - ▶ decline in lung function



antibiotic resistance ?

macrolide-resistant NTM  
rule out NTM infection  
rule out a prolonged QT interval

# TREATMENT

- ▶ (1) administration of an oral antibiotic
  - ▶ ciprofloxacin daily for 1–2 weeks per month;
- ▶ (2) use of a rotating schedule of oral antibiotics
- ▶ (3) administration of a macrolide antibiotic daily or 3 times/ week
  - ▶ anti-inflammatory effects
  - ▶ reduction of gram-negative bacillary biofilms
- ▶ (4) inhalation of aerosolized antibiotics (tobramycin inhalation solution)
  - ▶ 30 days on, 30 days off
- ▶ (5) intermittent administration of IV antibiotics ( “clean-outs”)
  - ▶ more severe bronchiectasis and/or resistant pathogens

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# Lung Abscess

**Rebecca M. Baron, Miriam Baron Barshak**



# Lung abscess

- ▶ necrosis and cavitation of the lung following microbial infection.
- ▶ single
- ▶ multiple
- ▶ single dominant cavity  $>2$  cm in diameter

# ETIOLOGY

- ▶ The low prevalence
- ▶ Significant morbidity and mortality
- ▶ primary (~80% of cases)
- ▶ Secondary

# ETIOLOGY

## Primary lung abscesses

- ▶ Aspiration
  - ▶ anaerobic bacteria
  - ▶ absence of an underlying pulmonary or systemic condition



# ETIOLOGY

## Secondary lung abscesses

- ▶ setting of an underlying condition
  - ▶ Post obstructive process (bronchial foreign body or tumor)
  - ▶ systemic process (e.g., HIV infection or another)

# Lung abscesses

- ▶ Acute (<4–6 weeks in duration)
- ▶ Chronic (~40% of cases)

# EPIDEMIOLOGY

- ▶ middle-aged men > middle-aged women
- ▶ risk factor for primary lung abscesses is **aspiration**
  - ▶ altered mental status
  - ▶ Alcoholism
  - ▶ drug overdose,
  - ▶ Seizures
  - ▶ bulbar dysfunction
  - ▶ prior cerebrovascular or cardiovascular events
  - ▶ neuromuscular disease
  - ▶ esophageal dysmotility or esophageal lesions (strictures or tumors)
  - ▶ gastric distention and/or gastroesophageal reflux
  - ▶ **gingivitis and periodontal disease**

# Aspiration

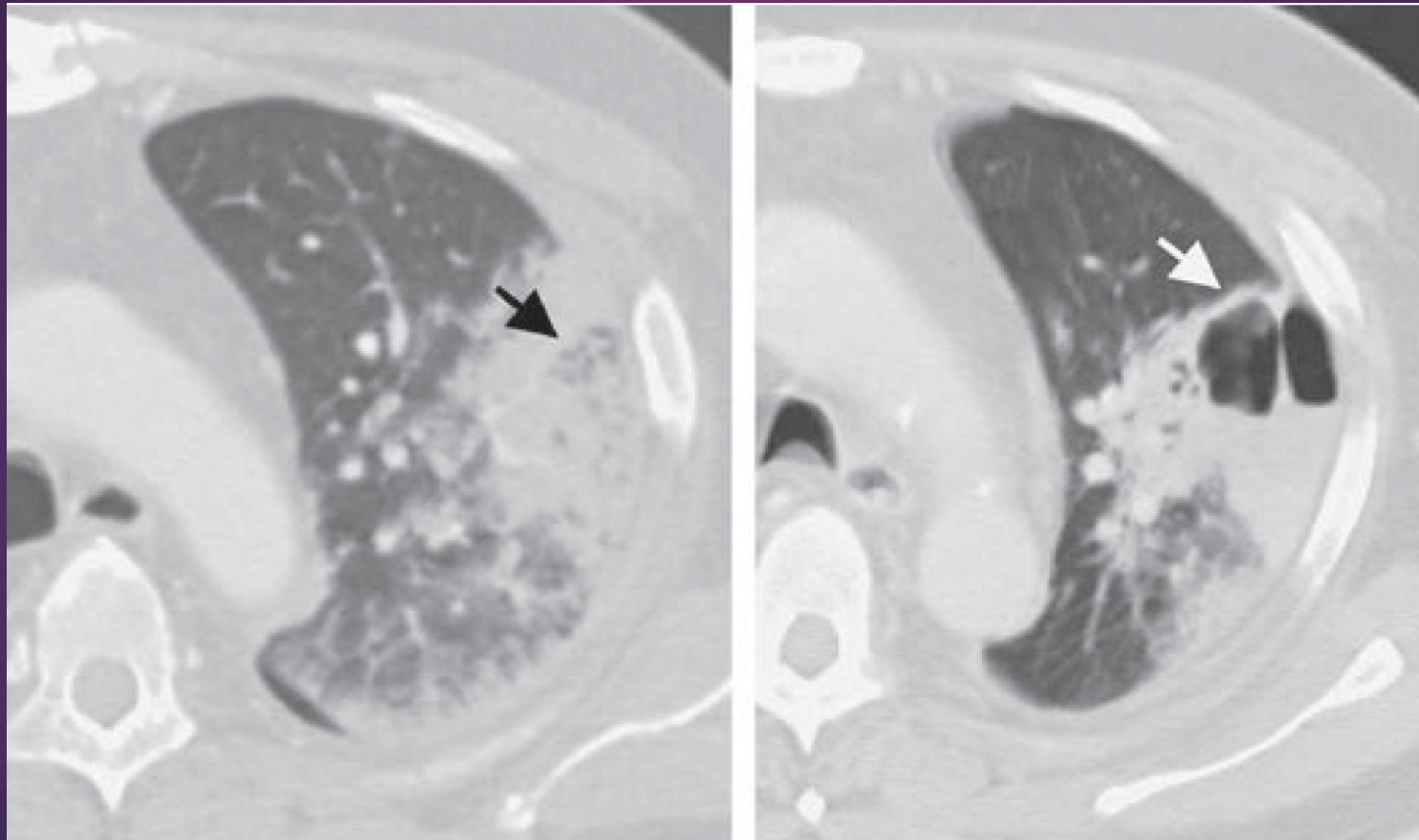
- ▶ Pneumonitis develops initially (tissue damage caused by gastric acid)
- ▶ over a period of 7–14 days, the anaerobic bacteria
  - ▶ parenchymal necrosis and cavitation
  - ▶ depends on host–pathogen interaction
- ▶ Anaerobes
- ▶ Polymicrobial infections
  - ▶ synergistically to cause more significant tissue destruction

# Primary lung abscess (usually with risk factors for aspiration)

- ▶ Anaerobes
  - ▶ Peptostreptococcus spp.,
  - ▶ Prevotella spp.,
  - ▶ Bacteroides spp.,
  - ▶ Streptococcus milleri),
- ▶ microaerophilic streptococci



underlying lymphoma  
severe *Pseudomonas aeruginosa* pneumonia



# Secondary Lung Abscesses

## ▶ **predisposing factor**

- ▶ bronchial obstruction from malignancy or a foreign body
- ▶ prevents clearance of oropharyngeal secretions,
  - ▶ leading to abscess development

## ▶ **underlying systemic conditions**

- ▶ immunosuppression after bone marrow or solid organ transplantation
- ▶ impaired host defense mechanisms
  - ▶ opportunistic organisms

## ▶ **septic emboli**

- ▶ tricuspid valve endocarditis (often involving *Staphylococcus aureus*)
- ▶ Lemierre's syndrome
  - ▶ infection begins in the pharynx (*Fusobacterium necrophorum*)
  - ▶ spreads to the neck and the carotid sheath (which contains the jugular vein)
  - ▶ cause septic thrombophlebitis.

# Secondary Lung Abscesses with underlying immunocompromise

- ▶ *Staphylococcus aureus*
- ▶ gram-negative rods
  - ▶ *Pseudomonas aeruginosa*
  - ▶ Enterobacteriaceae
- ▶ *Nocardia* spp.
- ▶ *Aspergillus* spp.
- ▶ Mucorales
- ▶ *Cryptococcus* spp.
- ▶ *Legionella* spp.
- ▶ *Rhodococcus equi*,
- ▶ *Pneumocystis jirovecii*

# Secondary Lung Abscesses

## ▶ **Endemic infections**

- ▶ *Mycobacterium tuberculosis*
  - ▶ *Mycobacterium avium*
  - ▶ *Mycobacterium kansasii*
- ▶ *Coccidioides* spp
- ▶ *Histoplasma capsulatum*
- ▶ *Blastomyces* spp
- ▶ parasites
  - ▶ *Entamoeba histolytica*
  - ▶ *Paragonimus westermani*
  - ▶ *Strongyloides stercoralis*

# Miscellaneous conditions

- ▶ Bacterial pathogen (often *S. aureus*) after influenza or another viral
- ▶ *Actinomyces* spp

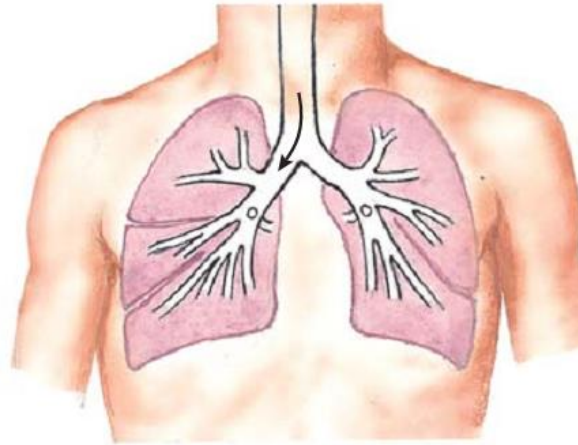
# ■ PATHOLOGY AND MICROBIOLOGY

## Primary Lung Abscesses

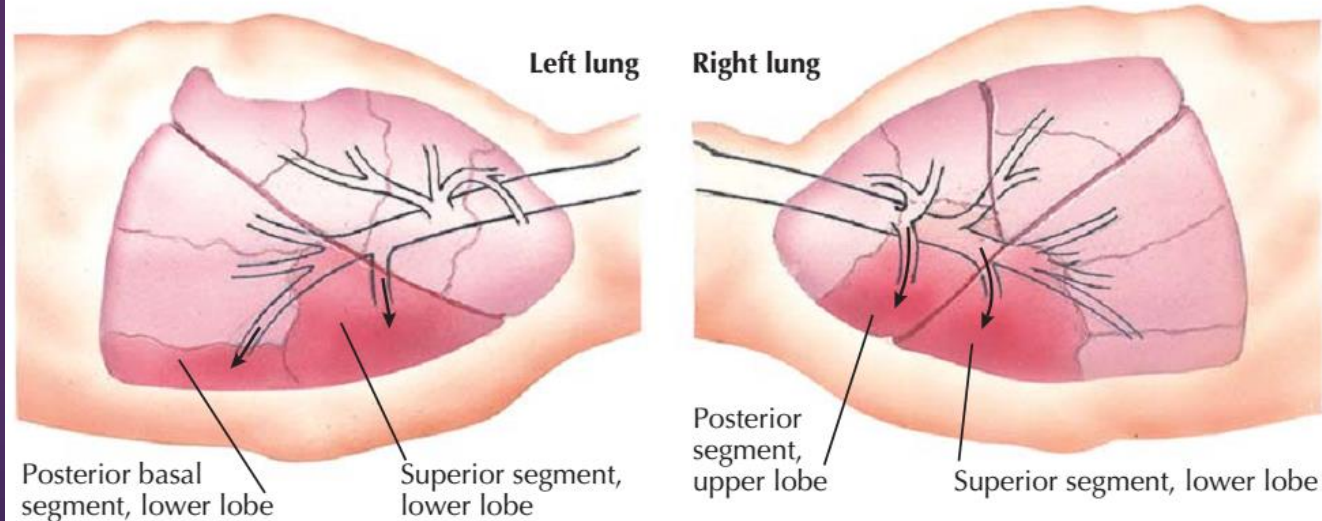
- ▶ The dependent segments
- ▶ Posterior upper lobes
- ▶ superior lower lobes
- ▶ right lung is affected more commonly
- ▶ often polymicrobial,
  - ▶ anaerobic organisms
  - ▶ Microaerophilic streptococci



# A.P



Right main bronchus is more in line with trachea than is the left, so that aspiration is more likely and incidence of abscess is greater on right side



# ■ PATHOLOGY AND MICROBIOLOGY

## Primary Lung Abscesses

- ▶ A putrid lung abscess
- ▶ foul-smelling breath, sputum, or empyema;



- ▶ anaerobic lung abscess

# ■ PATHOLOGY AND MICROBIOLOGY

## Secondary Lung Abscesses

- ▶ location of secondary abscesses may vary with the underlying cause
  - ▶ *Pseudomonas aeruginosa* and other gram-negative rods
  - ▶ fungal infections among immunosuppressed patients
- ▶ immunocompromised hosts
  - ▶ unusual organisms

# CLINICAL MANIFESTATIONS

## lung abscesses

- ▶ similar to those of pneumonia,
  - ▶ fevers, cough, sputum production, and chest pain
- ▶ a more chronic and indolent presentation anaerobic lung abscesses
  - ▶ night sweats, fatigue, and anemia
- ▶ putrid lung abscesses
- ▶ discolored phlegm
- ▶ foul-tasting or foul-smelling sputum
- ▶ Due to non-anaerobic organisms, such as *S. aureus*
  - ▶ More fulminant course high fevers and rapid progression

# physical examination

- ▶ Fevers
- ▶ poor dentition, and/or gingival disease
- ▶ amphoric and/or cavernous breath sounds on lung auscultation.
- ▶ digital clubbing
- ▶ absence of a gag reflex

# DIFFERENTIAL DIAGNOSIS

- ▶ broad & noninfectious processes that result in cavitary lung lesions
- ▶ lung infarction
- ▶ Malignancy
- ▶ Sequestration
- ▶ cryptogenic organizing pneumonia
- ▶ Sarcoidosis
- ▶ vasculitides and other autoimmune diseases
  - ▶ granulomatosis with polyangiitis
- ▶ lung cysts or bullae containing fluid
- ▶ septic emboli (e.g., from tricuspid valve endocarditis).
- ▶ pulmonary manifestations of diseases other than the chest
  - ▶ inflammatory bowel disease
  - ▶ pyoderma gangrenosum



# DIAGNOSIS

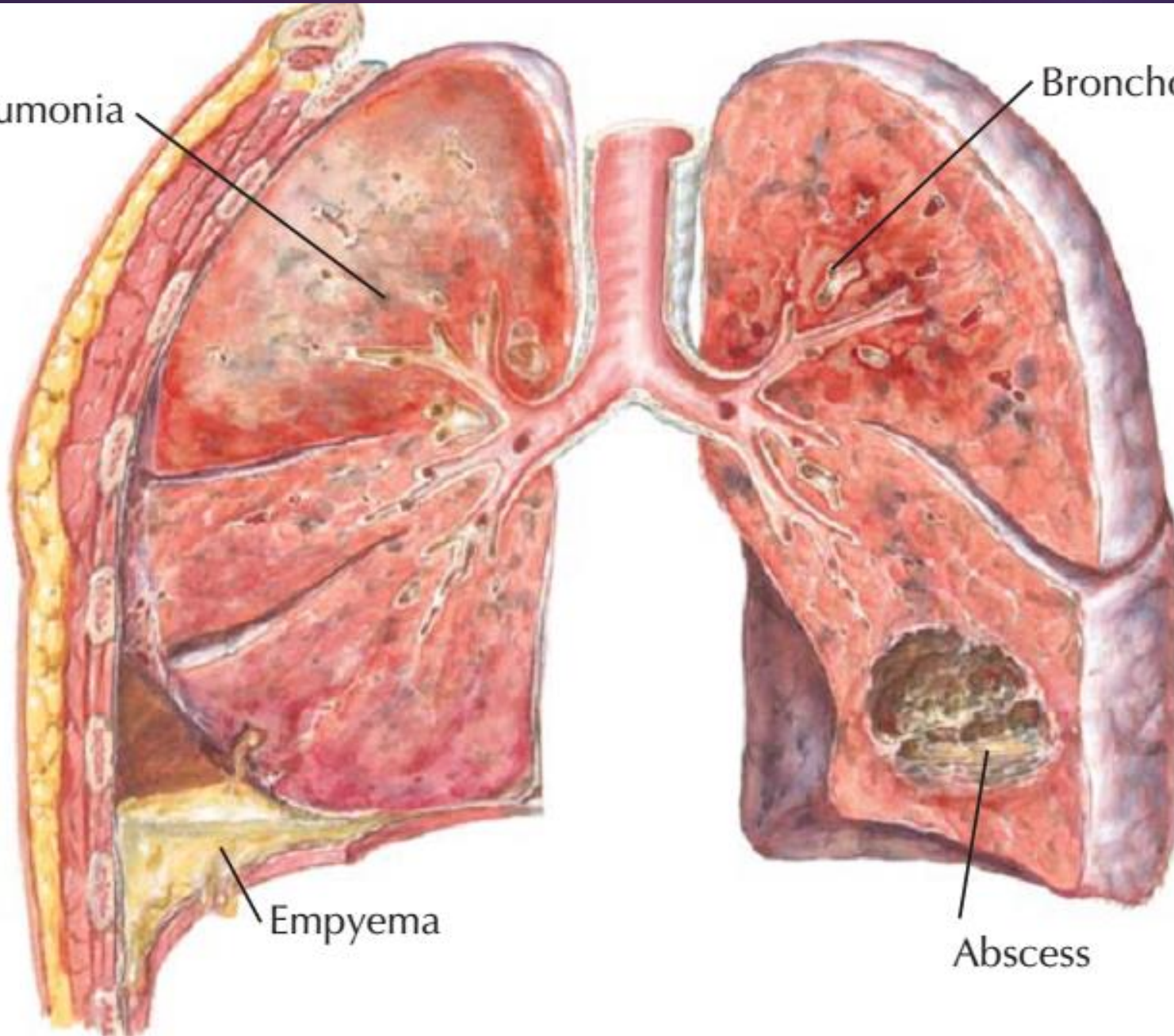
- ▶ chest imaging
- ▶ thick-walled cavity with an air-fluid level,
- ▶ CT may also yield additional information
- ▶ Malignancy
- ▶ distinguish a peripheral lung abscess from a *pleural infection*
  - ▶ *require urgent drainage*

Lobar pneumonia

Bronchopneumonia

Empyema

Abscess



# DIAGNOSIS

- ▶ more invasive diagnostics (such as transtracheal aspiration)
- ▶ Empirical therapy that includes drugs targeting anaerobic organisms
- ▶ polymicrobial, and culture results may not reflect
- ▶ putrid-smelling sputum
  - ▶ anaerobic infection

# DIAGNOSIS

- ▶ secondary lung abscess
- ▶ empirical therapy fails
- ▶ sputum and blood cultures
  - ▶ viruses and fungi
- ▶ Bronchoscopy with BAL or protected brush specimen collection
  - ▶ spillage of abscess contents into the other
- ▶ CT-guided percutaneous needle aspiration
  - ▶ pneumothorax
  - ▶ bronchopleural fistula
- ▶ secondary abscesses, especially in immunocompromised hosts,

# TREATMENT

## Lung Abscess


- ▶ 1940s and 1950s
- ▶ 3–4 weeks to as long as 14 weeks
- ▶ (1) clindamycin
- ▶ (2) IV-administered  $\beta$ -lactam/ $\beta$ -lactamase combination
- ▶ 3 - moxifloxacin (400 mg/d PO)
- ▶ Metronidazole is not effective as a single agent:
  - ▶ not the microaerophilic streptococci

# TREATMENT

## secondary Lung Abscess

- ▶ **identified pathogen, and a prolonged course**

- ▶ if the primary lung abscess fails to improve



additional  
studies to  
rule out

- ▶ underlying predisposing cause for a secondary lung abscess



- ▶ 10–20% of patients may not respond at all
  - ▶ continued fevers and progression of the abscess cavity on imaging
  - ▶ surgical resection
  - ▶ percutaneous drainage of the abscess
- ▶ An abscess >6–8 cm in diameter is less likely to respond to antibiotic
- ▶ complications of percutaneous drainage
  - ▶ Bacterial contamination of the pleural space
  - ▶ Pneumothorax
  - ▶ Hemothorax

# COMPLICATIONS

- ▶ Larger cavity size
  - ▶ Persistent cystic changes (pneumatocoeles)
  - ▶ Bronchiectasis
- ▶ recurrence of abscesses
- ▶ Empyema
- ▶ life-threatening hemoptysis
- ▶ massive aspiration of lung abscess contents

# PROGNOSIS AND PREVENTION

- ▶ mortality rates for primary abscesses have been as low as 2%,
  - ▶ secondary abscesses 75%
- ▶ poor prognostic
  - ▶ Age of >60
  - ▶ presence of aerobic bacteria
  - ▶ sepsis at presentation
  - ▶ symptom duration of >8 weeks
  - ▶ abscess size of >6 cm.

# PROGNOSIS AND PREVENTION

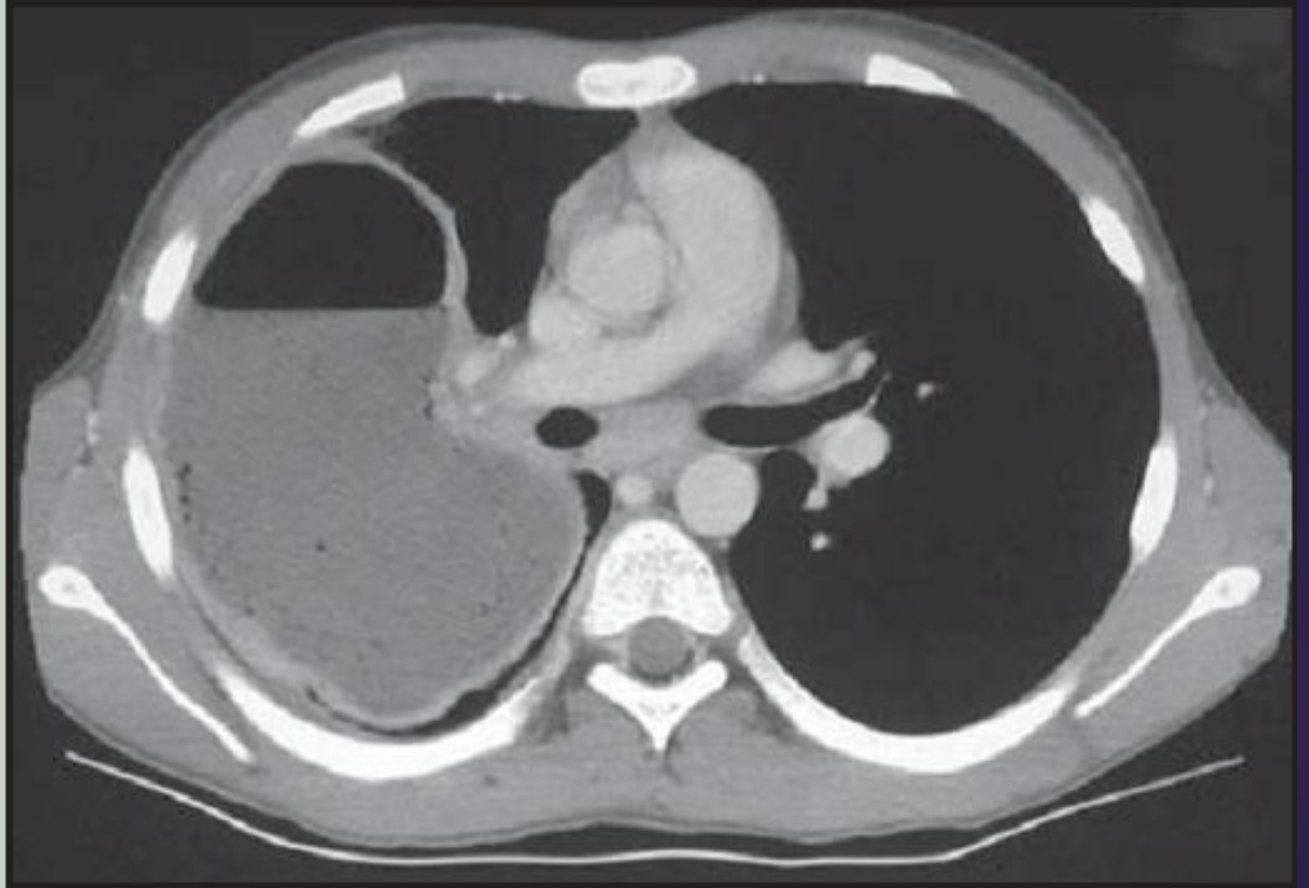
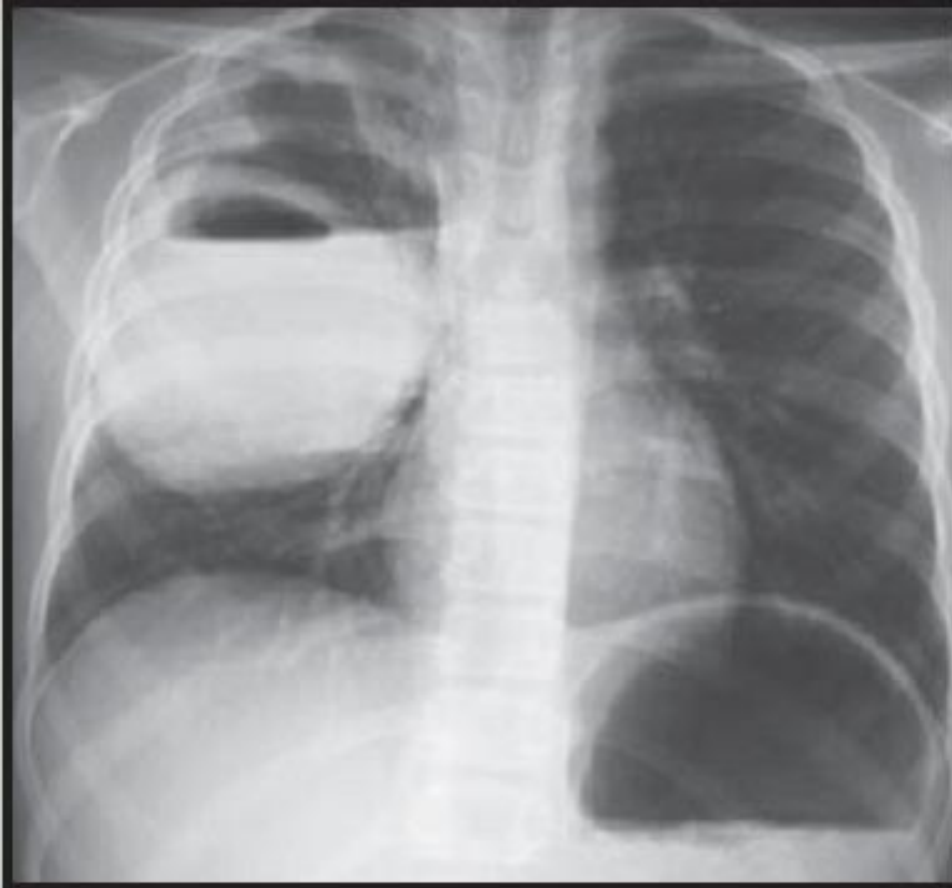
- ▶ underlying risk factors ➡ prevention of lung abscesses
- ▶ Airway protection
- ▶ oral hygiene
- ▶ minimized sedation
- ▶ elevation of the head of the bed
- ▶ Prophylaxis against certain pathogens in at-risk patients
  - ▶ bone marrow or solid organ transplants
  - ▶ HIV infection

# APPROACH TO THE PATIENT

## Lung Abscess

- ▶ For patients with a lung abscess
  - ▶ low likelihood of malignancy (smokers <45 years old)
  - ▶ with risk factors for aspiration
- ▶ empirical treatment and then to pursue further evaluation if therapy does not elicit a response
- ▶ **risk factors for malignancy**
- ▶ **underlying conditions (especially immunocompromised hosts)**
- ▶ **atypical presentation,**
- ▶ earlier diagnostics should be considered
- ▶ bronchoscopy with biopsy or CT-guided needle aspiration.
  - ▶ consistent with possible bronchial obstruction.
- ▶ endemic for tuberculosis or patients with other risk factors for tuberculosis
  - ▶ induced sputum samples

# Lung abscess



CA-MRSA, oral anaerobes, endemic fungi, *M. tuberculosis*, atypical mycobacteria